Department of Energy
Review Committee Report

on the

Technical, Cost, Schedule, and
Management Review

of the

Oak Ridge National Laboratory
Nanoscale Science Research Center Project

CENTER for NANOPHASE MATERIALS SCIENCES (CNMS)

April 2005

EXECUTIVE SUMMARY

A Department of Energy (DOE) Office of Science project review of the Center for Nanophase Material Sciences (CNMS) was conducted at Oak Ridge National Laboratory (ORNL) on April 4-5, 2005. The review was conducted at the request of Dr. Patricia M. Dehmer, Associate Director for the Office of Basic Energy Sciences, Office of Science and the project's Acquisition Executive. The purpose of the review was to assess the project's readiness to proceed to Critical Decision (CD) 4a, Approve Start of Initial Facility Operations as defined in the Project Execution Plan (PEP), Revision 2.

The Committee concluded that the project will be ready for CD-4a as of April 30, 2005, as planned in the PEP, Revision 2. At CD-4a, the project will be building safe and ready to accept equipment. The Committee approved a checklist for Beneficial Occupancy that will be completed for CD-4a. While the checklist is challenging, the Committee felt that it would be achievable by the CD-4a date.

The CNMS project is a highly collaborative, multi-disciplinary research center, co-located with the Spallation Neutron Source and the proposed Joint Institute for Neutron Sciences at ORNL. The CNMS is approximately 80,000 square feet, consisting of a four-story office and laboratory building and a connected single-story, clean-room building. The Total Project Cost is $64.7 million. As of the end of February 2005, the project was 64 percent complete compared to a planned 66 percent complete. The project will be complete at CD-4b, Approve Start of Full Operations, scheduled for September 2006. Overall remaining cost contingency is $3.4 million. This is 15 percent of the remaining costs, which is adequate for this stage of the project. There is one week of schedule contingency for the CD-4a date, and three and one-half months for the CD-4b date.

Overall, the Committee concluded that the CNMS project was being managed effectively. The scope and specifications were sufficiently defined to support the cost and schedule presented, and consistent with the FY 2005 Project Data Sheet and the PEP, Revision 2. The information in the DOE Project Assessment Reporting System (PARS) is consistent with physical progress. The ES&H aspects of the project were adequately addressed and Integrated Safety Management principles are being followed. The project had responded appropriately to the recommendations from past DOE reviews. There was one Committee recommendation resulting from this review.

In summary, the Committee concluded that completion of CD-4a by April 30, 2005 is challenging but achievable.

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1. INTRODUCTION

The Center for Nanophase Materials Sciences (CNMS) will integrate nanoscale research with neutron science; synthesis science; and theory, modeling, and simulation—bringing together four areas in which the United States has clear national research needs, and creating synergies that will have significant impact on scientific research by accelerating the pace of scientific discovery. The tools and scientific expertise of CNMS will be accessible to university, industrial, and laboratory researchers through a peer review process. The external scientific community has been an essential partner in developing and operating CNMS so that it is successful in achieving its scientific and technical mission.

The CNMS major scientific thrusts will be in nano-dimensional "soft" materials; complex nanophase materials systems; and theory, modeling, and simulation. The CNMS will provide access to the full cycle of materials design, synthesis, characterization and analysis, and properties-modeling capabilities at the nanoscale. This full-cycle access will rapidly advance understanding and permit tackling problems of a scope, disciplinary breadth, and complexity that is beyond current capabilities. The CNMS will provide the research infrastructure and environment needed to support highly collaborative research and multidisciplinary research education, including resident scientific collaborators, both long- and short-term visiting scientist positions, and technical support personnel.

The CNMS will use the intense neutron beams available at the new Spallation Neutron Source (SNS) and the upgraded High Flux Isotope Reactor to make broad classes of related nanoscale phenomena accessible to fundamental study for the first time. The significance of this neutron science focus is that neutron scattering provides unique information about both static and dynamic nanoscale self-organization that is complementary to data provided by other techniques. The CNMS will play an important role in strengthening the U.S. based neutron science community by helping it to provide scientific leadership in emerging research on nanoscale materials and processes. The CNMS will be co-located with the SNS and the Joint Institute for Neutron Sciences on the SNS "new campus".

The CNMS will occupy a nearly 80,000-square-foot building containing "wet" and "dry" materials synthesis and characterization laboratories; clean rooms; materials imaging, manipulation, and integration facilities; computer-access laboratories; and office space for staff and visitors. The layout of the office-laboratory complex is designed to maximize collaborative, multidisciplinary, and educational interactions.

The CNMS was selected for construction after an extensive peer review conducted at the end of April 2001. Five proposals from national laboratories were received for the establishment of five Nanoscale Science Research Centers (NSRC). The process for selection of the NSRCs involved review of the proposals by a group of experts having knowledge of both nanoscale science and the operation and management of centers and user facilities. The review included examination of the written proposals and oral presentations by each laboratory proposing an NSRC. The reviewers provided individual evaluations of each proposal. After consideration of their comments, proposals were ranked according to the criteria established.

The Total Project Cost (TPC) of the CNMS project is $64.7 million. This includes a Total Estimated Cost (TEC) of $63.7 million and $1 million of Other Project Costs. The TEC includes approximately $25 million, including contingency, allocated to technical instrumentation. CD-0, Approve Mission Need, was approved and the project validated in June 2001. The overall cost contingency remaining is $3.4 million, which is 15 percent of the remaining costs. The overall schedule contingency is three months and three weeks, with a project completion date (CD-4b) planned for September 2006.

2. SCIENTIFIC PROGRAM

2.1 Findings

The CNMS continues to refine and implement its vision for scientific leadership in seven theme areas, which build on internationally recognized strengths at ORNL. CNMS theme leaders include senior staff and key management personnel, thereby ensuring that the CNMS user program will fully exploit ORNL expertise, leverage existing laboratory capabilities, and include an appropriate balance of unique, specialized instrumentation and more general nanoscience fabrication and characterization tools.

The technical equipment baseline is $21.82 million. Costs remain within the baseline.

A total of 55 percent of the technical equipment cost has been committed. Quotations are current and the specification and procurement process is underway for the remaining equipment. The cost risk for anticipated foreign procurements is adequately mitigated by project contingency.

Overall, the technical equipment specification process is on schedule to meet the project milestones and is functioning very well.

Remaining procurements are being actively managed to optimize benefits to the CNMS operating program. The Beowulf computing cluster will be upgraded from 32-nodes to 64-nodes. Visualization workstations will be substituted for the SGI graphic workstations. Placement of the 16-screen visualization wall within the theory institute area has been optimized for efficient space utilization. The technical equipment for the X-Ray Diffraction Laboratory is under active reconsideration in context of existing ORNL capabilities.

Major instrument procurement is well along. The factory acceptance test of the Direct Write Electron Beam Lithography System was completed in December 2004. Contract awards have been made for other major instruments (such as FIB/SEM, 4-Probe Transport STM, Spin-Polarized SEM).

A list of special equipment to be procured with residual contingency has been prepared. The stated prioritization process is based upon scientific justification, available funds, and ability to be fully operational prior to the scheduled CD-4b date. A high-field, solid state NMR instrument that was previously removed from baseline, remains a high-priority item if contingency funds become available.

A detailed, laboratory-by-laboratory commissioning document is in place, listing the laboratory function, responsible person, installed utilities, technical equipment, anticipated chemical inventory, preliminary RSS, and anticipated training requirements. The sequence of operational laboratories is given by the technical equipment installation and acceptance schedule.

A Transition to Operations plan for integrated CNMS/SNS operations exists and is being implemented.

2.2 Comments

The Committee expressed confidence in the leadership provided by the CNMS Director and Scientific Director.

The technical equipment specification and review process effectively incorporates external user input CNMS scientific and management review to ensure appropriateness for the CNMS User Facility mission.

2.3 Recommendations

None.

3. CONVENTIONAL FACILITIES

3.1 Findings

The CNMS conventional facilities are at approximately 96 percent complete, based upon the preliminary March 2005 monthly report, and are being readied for Beneficial Occupancy in April 2005. All major equipment is in the process of being bar coded and placed in ORNL's maintenance database system.

The Transition Team is scheduled to perform facility walk-downs to verify compliance with the construction contract documents. A punch list will be generated and will be used to resolve and track completion of incomplete activities.

An interim commissioning report prepared by an independent commissioning contractor will be prepared to verify that the building systems are ready for occupancy and installation of technical equipment. The CNMS project has adequately identified the criteria for Beneficial Occupancy or CD-4a. Although there are still many work tasks that require completion in a relatively short amount of time, completion of the items needed for Beneficial Occupancy in this time frame are achievable.

The method that will be used to assure safety and technical readiness for partial experimental operations in FY 2006 have been identified in the Transition to Operations Plan.

3.2 Comments

The CNMS criteria for Beneficial Occupancy definition are appropriate for the CNMS project; however, these criteria may not be appropriate for a facility that will transition immediately into some partial level of experimental operations once CD-4a is received. There are prerequisites for CD-4a in the Beneficial Occupancy definition that are not essential to beneficial occupancy, such as completion of all surface treatments and finishes.

The CNMS project has demonstrated, through increased staffing and added work shifts, that it can make substantial progress in a limited amount of time, thus providing confidence that Beneficial Occupancy Date in April is achievable.

The schedule and process that will be used to assure that all systems and conditions are

ready for the introduction of hazardous materials and the start of experimental operations should be expanded in the Transition to Operations plan.

3.3 Recommendation

1. Prepare a matrix listing the life safety systems, building systems and systems needed to support technical equipment that indicates the status of installation, testing and acceptance, training and documentation, and whether these items are required for CD-4a or start of experimental operations.

4. ENVIRONMENT, SAFETY AND HEALTH

The review addressed environment, safety and health (ES&H) aspects of the project at its current stage of development and assessed whether Integrated Safety Management (ISM) principles are being followed.

4.1 Findings

The project has demonstrated effective implementation of ISM principles in addressing ES&H aspects of operations within the CMNS. This is especially noted in facility planning for accommodating the use and storage of hazardous materials in the laboratory spaces. It is evident from the interviews conducted and documents reviewed that the CMNS Director is strongly engaged with the principle investigators and subject matter experts in identifying hazards through the Research Safety Summaries and defining the hazardous material control areas in order to keep chemical inventories within specified limits.

Fire Protection Systems are installed and complete. Verification and testing of fire sprinklers and alarms is scheduled for mid April 2005.

Evaluation of arc flash hazards of electrical equipment that will need to be operated during the equipment installation phase is currently under review and effected equipment will need to be labeled per NFPA 70E standard.

4.2 Comments

Current work control procedures prevent workers at CNMS from working on energized systems until potential arc flash protection boundaries are evaluated. The project should ensure that potentially effected equipment is prioritized for evaluation based on installation schedule needs.

4.3 Recommendations

None.

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5. COST ESTIMATE

5.1 Findings

The TPC of the project is $64.7 million as of Baseline Change Proposal (BCP) 10. The change from the baseline to current estimate is a result of a congressional budget rescission. This includes a TEC of $63.7 million and Other Project Cost of $1 million. A comparison to the original baseline cost estimate at the December 2002 DOE review is shown in Table 5-1.

Table 5-1. Original Baseline Cost Estimate Compared to BCP-10 ($K)

WBS	IPR	BCP-10
WBS 2.1 Technical Equipment	$24,910	$21,820
WBS 2.2 Conventional Facilities	$30,240	$38,520
Contingency (% of work to go including commitment)	$8,850 (16%)	$3,399 (15.1%)
Total TEC	$64,000	$63,739
Other Project Costs	$ 1,000	$ 1,000
Total TPC	$65,000	$64,739

Overall project contingency is currently estimated at $3.399 million or approximately 15.1 percent of the remaining costs. A Risk Assessment Plan is in place that identifies major areas of risk for the project and includes mitigating actions—it is reviewed monthly and formally updated as needed. Mitigating actions are underway to minimize consequences of identified concerns on the project. The Technical Equipment Plan includes a list of additional equipment that could be procured if sufficient funds remain near the end of the construction phase of the project.

5.2 Comments

The project's cost baseline is consistent with the FY 2005 Project Data Sheet and the PEP, Revision-2. The Committee concluded that the remaining contingency is adequate, taking into account that 55 percent of the technical equipment cost estimate has been committed and most of remaining cost estimates are based on vendor quotes. The contingency is supported by and consistent with an appropriate project-wide risk analysis.

5.3 Recommendations

None.

6. SCHEDULE and FUNDING

6.1 Findings

The project schedule of Critical Decision (CD) approvals is as follows:

CD-0	Approve Mission Need	June 13, 2001
CD-1	Approve Preliminary Baseline Range	February 22, 2002
CD-2	Approve Performance Baseline	September 5, 2002
CD-3	Approve Start of Construction	February 3, 2003
CD-4a	Approve Start of Initial Operations	April 30, 2005
CD-4b	Approve Start of Full Operations	September 30, 2006

The overall project is 64 percent complete through February 2005, compared to a planned 66 percent. The conventional construction is 89.6 percent complete, compared to the plan of 92.6 percent. The construction contractor has added resources and is performing second shift work to recover the schedule variance.

Technical equipment is 18.9 percent complete versus 19.6 percent planned.

There is approximately one week of schedule contingency for the CD-4a date and two and one-half months for the CD-4b date.

The current funding profile per the FY 2005 Project Data Sheet is shown in Table 6-1.

Table 6-1. Budget Authority Profile (million dollars)*

	2001	2002	2003	2004	2005	2006	Total
TEC-PED		1,500	988				2488
TEC Construction			23,701	19,882	17,669		61,252
OPC	250	225	100	250	100	75	1,000
Total	**250**	**1725**	**24789**	**20132**	**17769**	**75**	**64,740**

*The current Presidential budget submission includes funding for Transition to Operations for FY 2006.

6.2 Comments

The overall project schedule, project start, and project completion are consistent with the FY 2005 Project Data Sheet and the PEP, Revision-2.

The Committee concluded that considering the definition of CD-4a completion, the schedule for CD-4a date of April 30, 2005 is challenging.

The remaining schedule for the BOD milestone of approximately three to four weeks, including one week of contingency, is adequate.

The information in the PARS is consistent with physical progress.

6.3 Recommendations

None.

7. MANAGEMENT

7.1 Findings

The CNMS project continues to be managed appropriately for this stage of the project. The Integrated Project Team continues to demonstrate a good working relationship with frequent communications and regularly held (weekly and monthly) meetings and reports. The project team's plan to complete the project within cost and schedule remains credible based on project status at 64 percent complete and available contingency at 15 percent of the remaining work.

PARS reporting, which is produced from CNMS project's Earned Value Management System (EVMS), appears to reflect project conditions as status presented and observed in the facility walkthrough. Monthly and quarterly progress reports continue to be prepared by the Federal Project Director and comply with DOE management requirements.

Project risk analysis and contingency plans have been recently updated and remain credible and reasonable. Remaining contingency is approximately $3.4 million (15 percent) and appears to be adequate for this stage of the project.

7.2 Comments

The project continues to benefit from close interface with the SNS project; with monthly coordination meetings, shared staff for a coordinated approach, and the partnership planned to be extended into operations. Continuation of this partnership is recommended.

The CNMS project has recently updated the risk management plan and revised contingency requirements for remaining project components. A list was developed of scientific equipment which can be obtained with any remaining project funds; selection will be based on scientific justification, cost, and delivery schedule. The use of contingency for facility related costs is a reduced priority at this time.

The CNMS has developed a Project Transition Plan that provides a clear roadmap to beneficial occupancy and operations for CNMS. The plan clearly defines Federal and contractor roles in the facility acceptance process. The Transition Plan provides a summarized facility BOD for CD-4a; this definition is further detailed in the CNMS Conventional Facility Beneficial Occupancy Definition.

7.3 Recommendations

None.

APPENDIX A

CHARGE MEMORANDUM

United States Government Department of Energy

memorandum

DATE: March 11, 2005

REPLY TO ATTN OF: SC-10

SUBJECT: CNMS CD-4a Review

TO: Daniel R. Lehman, Director, SC-81

I am requesting your office to perform an on-site review of the Center for Nanophase Materials Sciences (CNMS) project at Oak Ridge National Laboratory (ORNL) on April 4-5, 2005. The purpose of the review is to assess the project's readiness to proceed to Critical Decision 4a (CD-4a), Approve Start of Initial Facility Operation as defined in the Project Execution Plan (PEP). The review committee is asked to assess the status of the project with respect to both the general prerequisites for CD-4a, and the CNMS Conventional Facilities Beneficial Occupancy definition, which was developed by the Federal Project Director.

In carrying out its charge, the Committee should respond to the following questions:

1. Is the CNMS Conventional Facility Beneficial Occupancy definition complete, and sufficient for start of initial facility operation? Will the CNMS facility have satisfied this definition by CD-4a? Does the facility have a plan for supporting research users in conducting BES programmatic (i.e., non-TPC funded) activities?

2. Is the CNMS project being managed properly and are the project's cost, schedule, and technical baselines consistent with the FY05 Project Data Sheet and the PEP? Does the plan for remaining procurements realistically support the schedule for project completion (CD-4b)? Does this plan include appropriate contingency (cost and schedule) for project completion?

3. Is there a Transitions to Operations Plan in place for CD-4a?

4. Are ES&H aspects being properly addressed given the project's current stage of development? Are Integrated Safety Management Principles being followed?

5. Has the project responded appropriately to recommendations from prior DOE/SC reviews?

Kristin Bennett, the NSRC Program Manager for CNMS, will serve as the Basic Energy Sciences point of contact for this review. I would appreciate receiving your committee's report within 60 days of the review's conclusion.

I wish to thank you in advance for agreeing to carry out this review. I look forward to receiving your committee's report.

Patricia M. Dehmer
Associate Director of Science
for the Office of Basic Energy Sciences

APPENDIX B

REVIEW PARTICIPANTS

Department of Energy Review of the
Center for Nanophase Materials Sciences (CNMS) Project at ORNL

REVIEW COMMITTEE PARTICIPANTS

Department of Energy

Daniel Lehman, DOE/SC, Chairperson
Steve Tkaczyk, DOE/SC
Kin Chao, DOE/SC

Committee

Jim Beals, SNL
Marty Fallier, BNL
Frank Gines, DOE/Argonne
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Observers

David Arakawa, DOE/ORO
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Pat Dehmer, DOE/SC
Jeff Hoy, DOE/SC
Pedro Montano, DOE/SC
Les Price, DOE/ORO
David Wilfert, DOE/ORO

APPENDIX C

REVIEW AGENDA

Department of Energy Review of the
Center for Nanophase Materials Sciences (CNMS) Project at ORNL

AGENDA

Monday April 4, 2005—SNS/CLO Building (Bldg. 8600), Room 156

1:00 pm	DOE Executive Session	Lehman
1:30 pm	Welcome: Department of Energy	Dehmer/Bennett/Arakawa
	Welcome: Oak Ridge National Laboratory	Roberto/Buchanan
1:45 pm	CMNS Overview	Horton
2:15 pm	Conventional Facility Status	Stellern
3:00 pm	Technical Equipment (including hook-up discussion)	Horton/Stellern
3:45 pm	Break and CNMS Tour	All
5:00 pm	DOE Executive Session	
6:30 pm	Adjourn	

Tuesday, April 5, 2005

8:00 am	Transition to Operations	Horton/ Stellern/McLaughlin
8:30 am	Subcommittee Working Sessions	
10:00 am	DOE Executive Session Dry Run	Lehman
12:00 pm	Lunch	
1:00 pm	Closeout Presentation to CNMS Management	Lehman
2:00 pm	Adjourn	

APPENDIX D

COST TABLE

Project Baseline and Cost Status

		Baseline (Based on BCP-10)	Cost to Date Through Feb. 28, 2005	Cost plus Commitments
2.1	**Technical Equipment**			
	2.1.1 Technical Equipment	20,065,000	3,594,077	11,183,881
	2.1.2 Procurement Support	100,000	48,665	48,665
	2.1.3 Installation	565,000	0	0
	2.1.4 Test & Checkout	245,000	6,425	6,425
	2.1.5 Specification Development	155,000	142,239	158,732
	2.1.6 Project Mgmt (during Design)	55,000	50,735	50,735
	2.1.6 Project Mgmt (during Construction)	635,000	248,899	248,899
	Technical Equipment Subtotal	***21,820,000***	***4,091,040***	***11,697,337***
2.2	**Conventional Facility**			
	2.2.1 Design	2,067,000	2,046,963	2,046,963
	2.2.2 Construction	32,322,000	29,245,120	30,118,251
	2.2.3 Project Management	405,000	224,568	224,568
	2.2.4 Design Support	366,000	365,672	365,672
	2.2.5 Construction Management	1,800,000	1,204,541	1,451,401
	2.2.6 Construction Support	700,000	375,706	553,904
	2.2.7 Title III Service	860,000	809,406	809,406
	Conventional Facility Subtotal	***38,520,000***	***34,271,976***	***35,570,165***
Total Estimated Cost (TEC):		***60,340,000***	***38,363,016***	***47,267,502***
2.3	**Other Project Costs**			
	2.3.1 CDR/VE Study	378,000	377,142	377,142
	2.3.2 Scientific Scope Development	105,000	104,288	104,288
	2.3.3 ESH Documentation/training	485,000	6,576	6,576
	2.3.4 Engineering Support	32,000	32,148	32,148
	Other Project Costs Subtotal	***1,000,000***	***520,154***	***520,154***
Baseline Total:		***61,340,000***	***38,883,170***	***47,787,656***
CONTINGENCY (15%)		***3,399,000***		
Total Project Cost (TPC):		**64,739,000**		**74%**

APPENDIX E

SCHEDULE CHART

CNMS Schedule